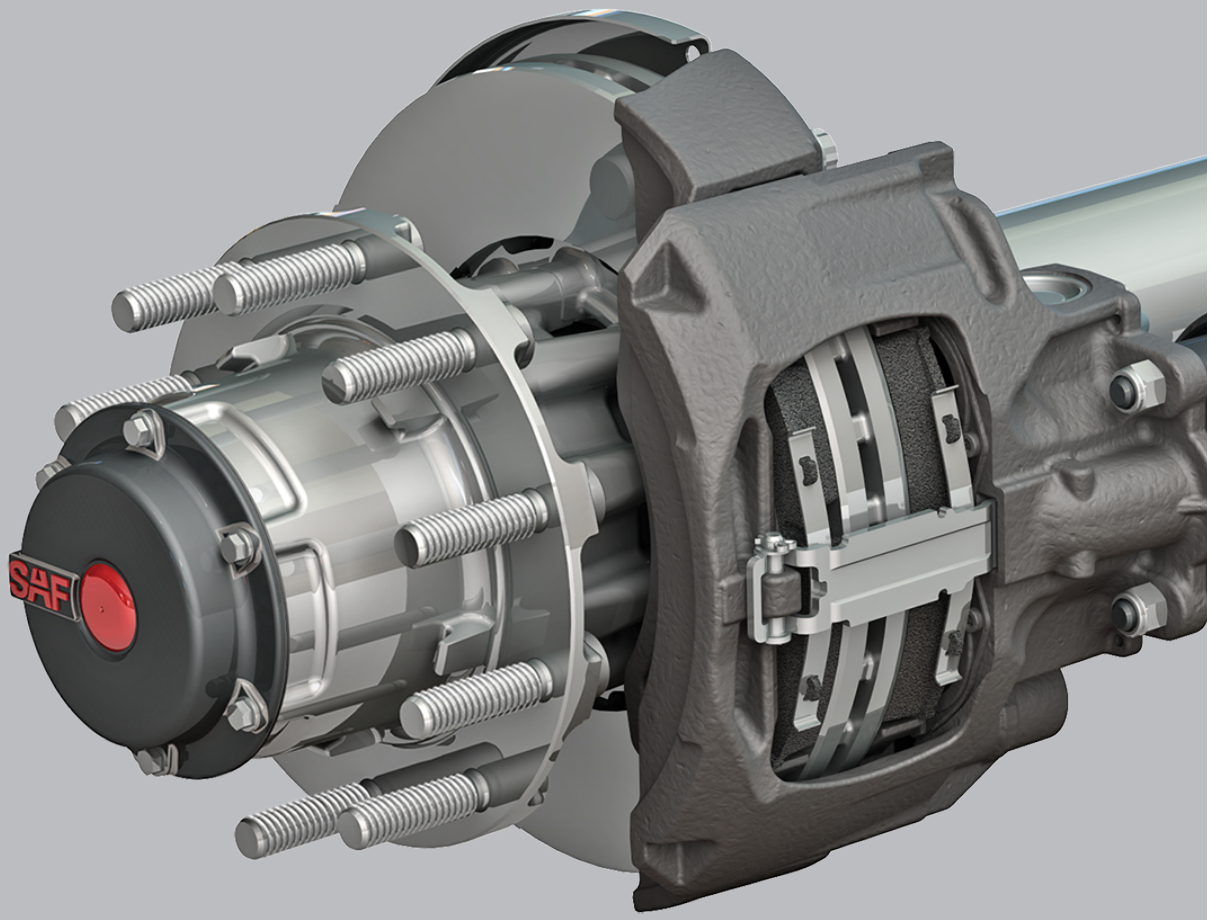
SAF-HOLLAND Group

Service Manual

INTEGRAL® Disc Brake Axles

P89 Parallel Spindle



XL-SA20018UM-en-US Rev B

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Introduction

This manual provides the necessary information for the maintenance, inspection and safe operation of the SAF® INTEGRAL® disc brake system with P89 spindle.

Knorr/Bendix is the manufacturer of the disc brake caliper assembly described in this service manual, not SAF-HOLLAND®. This manual references service documents which are published by Knorr/Bendix. The latest versions can be found on the website at www.bendix.com. These document references are intended to provide additional information when performing service work on the caliper assembly. SAF-HOLLAND® assumes no liability for the use of incorrect or unsuitable parts in the servicing or repair of the Knorr/Bendix disc brake caliper assembly. SAF-HOLLAND® assumes no liability for damages or claims arising out of incorrectly following procedures outlined in the Knorr/Bendix service manuals.

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Read this manual before using or servicing this product and keep it in a safe location for future reference. Updates to this manual, which are published as necessary, are available on the internet at www.safholland.us.

When replacement parts are required, SAF-HOLLAND® highly recommends the use of only SAF-HOLLAND® Original Parts. A list of technical support locations that supply SAF-HOLLAND® Original Parts and an Aftermarket Parts Catalog are available on the internet at www.safholland.us or contact Customer Service at 888-396-6501.

Warranty

Refer to the complete warranty for the country in which the product will be used. A copy of the written warranty is included with the product or available on the internet at www.safholland.com.

Notes, Cautions, and Warnings

Before starting any work on the unit, read and understand all the safety procedures presented in this manual. This manual contains the terms "NOTE", "IMPORTANT", "CAUTION", and "WARNING" followed by important product information. These terms are defined as follows:

NOTE: Includes additional information to enable accurate and easy performance of procedures.

IMPORTANT: Includes additional information that, if not followed, could lead to hindered product performance.

CAUTION Used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, could result in property damage.

⚠CAUTION Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

⚠WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

1. General Safety Instructions

General and Servicing Safety Instructions

- Read and observe all Warning and Caution hazard alert messages. The alerts provide information that can help prevent serious personal injury, damage to components, or both.

⚠WARNING Failure to follow the instructions and safety precautions in this manual could result in improper servicing or operation leading to component failure which, if not avoided, could result in death or serious injury.

- All maintenance should be performed by a properly trained technician using proper/special tools, and safe procedures.

NOTE: In the United States, workshop safety requirements are defined by federal and/or state Occupational Safety and Health Act (OSHA). Equivalent laws may exist in other countries. This manual is written based on the assumption that OSHA or other applicable employee safety regulations are followed by the location where work is performed.

- Properly support and secure the vehicle from unexpected movement when servicing the unit.

⚠WARNING Failure to properly support and secure the vehicle and axles prior to commencing work could create a crush hazard which, if not avoided, could result in death or serious injury.

- Several maintenance procedures in this manual require re-positioning of the brake chamber, brake calipers and/or ABS system. Consult the manufacturer's manual for procedures on the proper operation of brake chamber, brake calipers and/or ABS system.
- Service both roadside and curbside of an axle. Worn parts should be replaced in sets. Key components on each axle's braking system, such as friction material and rotors will normally wear over time.

IMPORTANT: Key components on each axle's braking system, including brake pads and brake rotors, are intended to wear over time. Worn parts should be replaced in sets on both the driver and curb side of an axle.

⚠WARNING Failure to follow manufacturer's instructions regarding spring pressure or air pressure control could allow uncontrolled release of energy which, if not avoided, could result in death or serious injury.

- The wheel contact surfaces between the wheel and hub MUST NOT receive additional paint.

IMPORTANT: The wheel contact surfaces MUST be clean, smooth and free from grease.

⚠WARNING Failure to keep wheel and hub contact surfaces clean and clear of foreign material could allow wheel/hub separations which, if not avoided, could result in death or serious injury.

- Only the wheel and tire sizes approved by the trailer builder can be used.

Operational and Road Safety Instructions

- Before operating vehicle, ensure that the maximum permissible axle load is not exceeded and that the load is distributed equally and uniformly.
- Make sure that the brakes are not overheated from continuous operation.

⚠WARNING Failure to minimize the use of brakes during overheating conditions could result in deterioration of brake efficiency which could result in death or serious injury.

- The parking brake MUST NOT be immediately applied when the brakes are overheated. Refer to the rotor wear inspection information in Section 5.2.

CAUTION If the parking brake is immediately applied to the brakes when overheated, the brake discs could be damaged by different stress fields during cooling.

- Observe the operating recommendation of the trailer manufacturer for off-road operation of the installed axles.

IMPORTANT: The definition of OFF-ROAD means driving on non-asphalt/non-concrete routes, e.g. gravel roads, agricultural and forestry tracks, on construction sites and in gravel pits.

IMPORTANT: Off-road operation of axles beyond the approved application design could result in damage and impair suspension system performance.

- SAF® axles require routine service, inspection and maintenance in order to maintain optimum performance, and operational safety as well as an opportunity to recognize natural wear and defects before they become serious. Refer to the Routine Service Schedule in Section 17.

⚠WARNING Failure to inspect and maintain the SAF-HOLLAND® INTEGRAL® disc brake axle as outlined in Section 17 can result in brake or wheel bearing failure which, if not avoided, could result in death or serious injury.

IMPORTANT: Use only SAF-HOLLAND® Original Parts to service the SAF-HOLLAND® INTEGRAL® disc brake axle.

⚠WARNING Failure to maintain the SAF-HOLLAND® INTEGRAL® disc brake with SAF-HOLLAND® Original Parts can result in brake or wheel bearing failure which, if not avoided, could result in death or serious injury.

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2. General Service and Maintenance Instructions

1. Conduct regular visual checks of the brakes, tires and all chassis components. Refer to Section 17 for more information:
   - Inspect for secure mounting, wear, leaks,corrosion and damage.
   - Check for loose, broken or cracked air hoses, air system leaks, and damaged components.
   - Check that brake hoses and cables are properly secured.
   - For proper brake pad wear, check that there is enough clearance to allow the caliper full movement during normal operation.
2. Check the brake pads at regular service intervals to ensure that the brake pad hold down springs are in the correct position, and that brake pads are not worn beyond the minimum wear limits described in this manual.
3. When replacing brake pads, inspect the rotors for signs of wear, cracks, grooves, scoring or hot spots.
4. Visually check the brake caliper at regular service intervals as defined by the brake caliper manufacturer's basic inspection program. Refer to Section 5.3 of this manual for further information.
5. Check the spring brake chambers to make sure the parking springs are NOT caged in the released position. Be sure the dust plugs are properly installed.
6. Make sure that the vent holes in the air brake chamber are not covered with snow, ice, mud, etc.
7. Inspect the wheel bearing unit for grease leaks at every brake pad change.
8. Visually check the brake assembly (e.g. pads, rotor, etc.) for oil or grease contamination.
9. Check that all dust caps and boots are present and in good condition.
10. Regularly conduct general safety checks in accordance with any applicable laws.
11. After every wheel change, the wheel nuts MUST be re-tightened to the specified torque level after the initial 100 miles of operation, and then at every regular service interval.

CAUTION Failure to re-tighten wheel nuts at specified intervals could result in component failure which, if not avoided, could result in damage to property.

IMPORTANT: Use only SAF-HOLLAND® Original Parts to service the SAF-HOLLAND® INTEGRAL® disc brake axle.

3. Model Identification

The disc brake axle serial tag is located near the center of the axle tube ***(Figure 1).***

4. Identification Tag

The sample tag shown will help interpret the information on the SAF-HOLLAND® USA, Inc. serial number tag. The model number, axle body part number and serial number are listed on the tag ***(Figure 2).***

Record the tag numbers below for future quick reference.

Axle Body Part Number: _____

Model Number: _____

Serial Number: _____

Figure 1

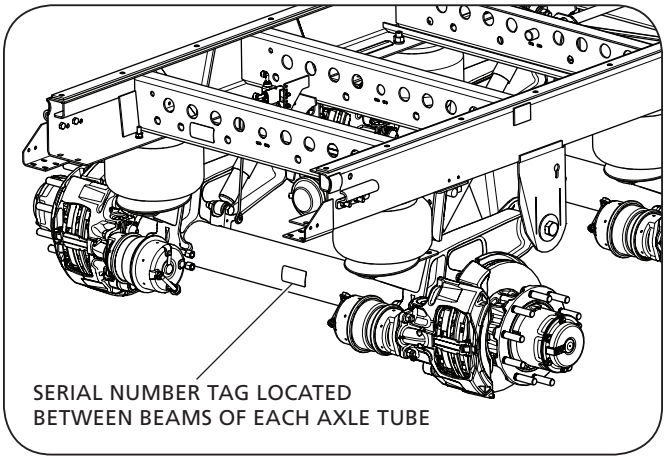
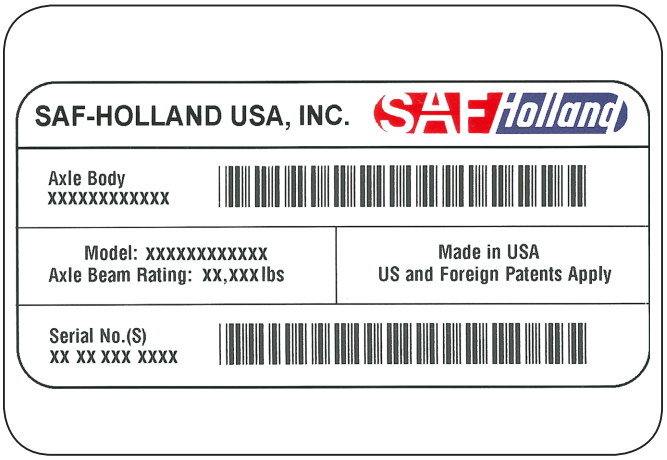


Figure 2



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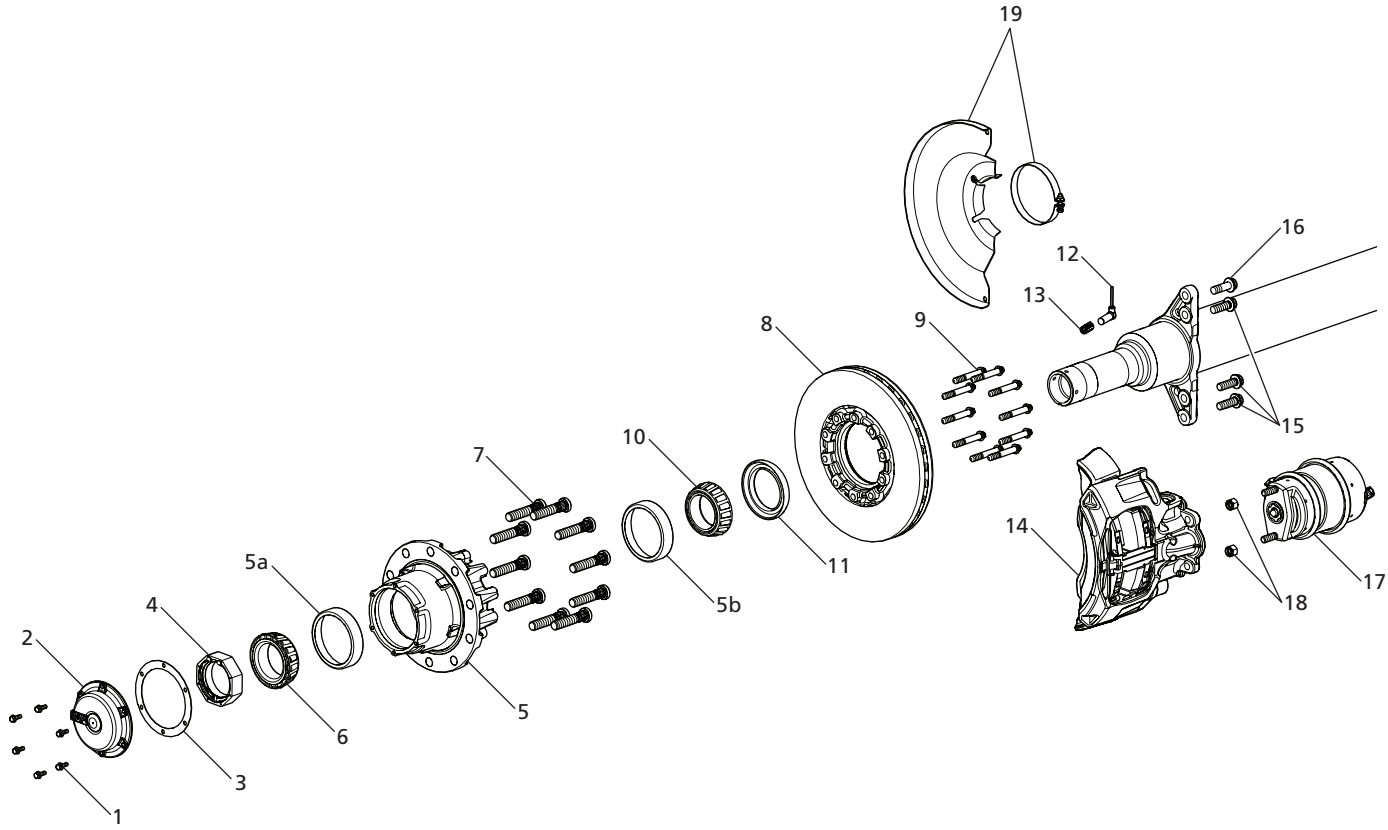


ITEM	DESCRIPTION	QTY. / AXLE
1	Bolt, Hub Cap	12
2	Hub Cap	2
3	Gasket, Hub Cap	2
4	Nut, Axle Pro-Torq®	2
5	Hub with Bearing Cups	2
5a*	Bearing Cup, Outer	2
5b*	Bearing Cup, Inner	2
6	Cone, Bearing, Outer	2
7	Wheel Studs	20
8	Rotor with ABS Tone Ring	2
9	Rotor Attachment Bolts	20

ITEM	DESCRIPTION	QTY. / AXLE
10	Cone, Bearing, Inner	2
11	Seal, Hub	2
12	ABS Sensor (WABCO)	2
13	Clamping Bush	2
14	Brake Caliper Left-Hand Brake Caliper Right-Hand	1
15	M18 x 1.5" Bolt, Standard	6
16	M18 x 1.5" Bolt, Shoulder	2
17	Brake Chamber	2
18	Brake Chamber nut	4
19	Dust Shield with Clamp (optional)	2

* Included in hub, item number 5, but can be serviced.

5. Disc Brake Inspection

IMPORTANT: During removal inspect components for wear and replace worn components.

⚠WARNING Failure to properly support axle during maintenance could allow axle to fall which, if not avoided, could result in death or serious injury.

NOTE: For further disc brake inspection information, refer to the latest version of the TMC recommended practice RP 652–Service and Inspection of Air Disc Brakes (TMC DVD supplement).

5.1 Pad Wear Inspection

Check the brake pads for proper thickness at regular service intervals based on vehicle usage. Brake pad inspections should be carried out at least every three (3) months or 20,000 miles, whichever comes first, and in accordance with any legal requirements. Refer to Routine Service Schedule in Section 17.

NOTE: Regular service intervals may be required more frequently for severe duty applications. Refer to Section 17.

A quick visual inspection of the condition of the brake pads can be performed without removing the wheel:

1. Compare the position of the caliper marking to the carrier marking located on the underside of the caliper unit ***(Figure 3)***.
   a. ***Figure 3*** - View A shows the positions of the two (2) markings when the brake pads are in good condition.
   b. ***Figure 3*** - View B shows the positions of the two (2) markings when the wheel MUST be removed for further inspection of wear to the brake pads and brake rotor.

For further inspection of the brake pads, the wheel and brake pads MUST be removed. Refer to the Knorr/Bendix SK7 brake pad change service data sheet SD-23-7541 Air Disc Brake which can be found at www.bendix.com for more information.

IMPORTANT: After inspecting the brake pads, check that the brake system is functioning properly.

IMPORTANT: When replacing worn brake pads, ALL pads on the axle MUST be replaced.

If the friction material of the brake pad is less than 0.43" (11 mm) at its thinnest area, the brake pad MUST be replaced. ***(Figure 6)***.

NOTE: Minor breakouts at the edges are permitted. Major breakouts on the surface of the brake pad are NOT permitted ***(Figure 4)***.

Figure 3

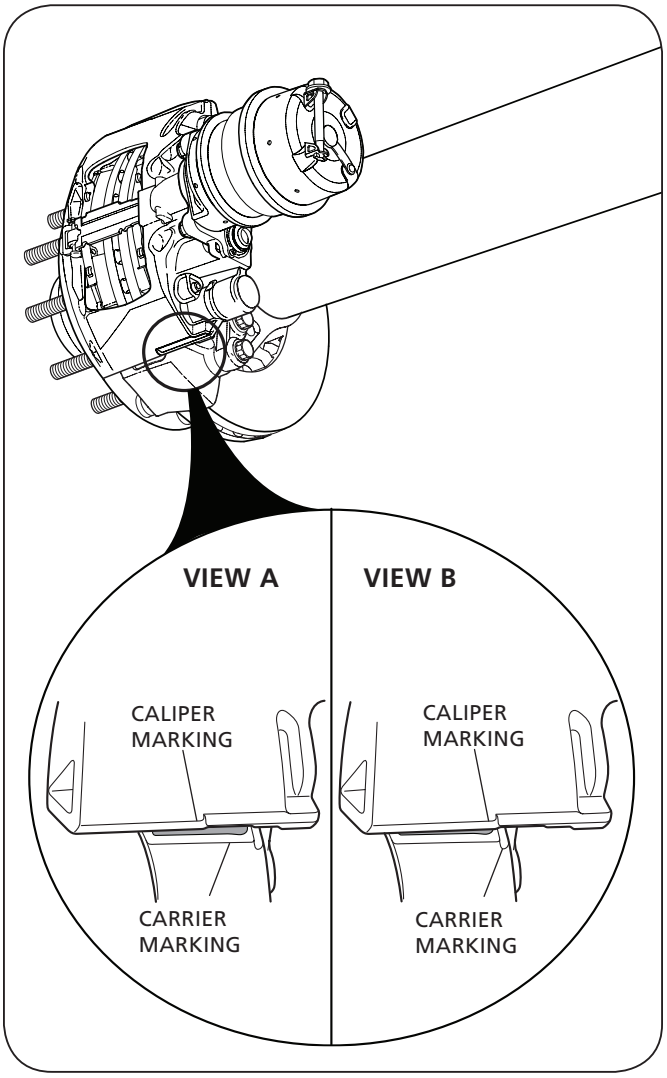
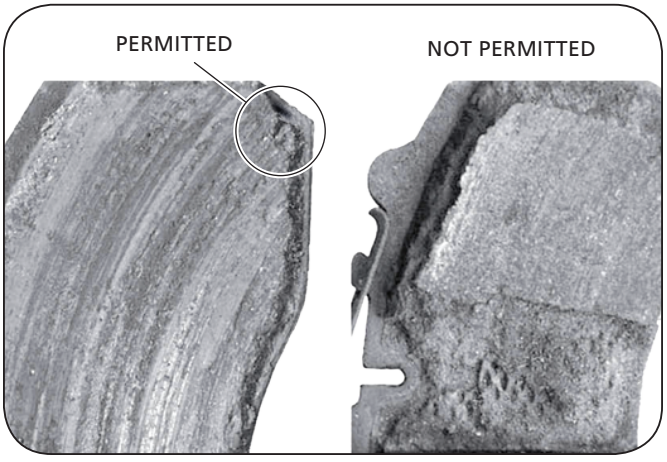


Figure 4



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5.2 Rotor Wear Inspection

1. Carefully inspect both sides of the brake rotor friction surface ***(Figure 5).***
   a. Spider web cracking is acceptable ***(Area A)***.
   b. Radial cracks less than 0.06" (1.5 mm) deep or wide with lengths less than 75% of the width of the rotor friction surface ***(Area B)*** are acceptable.
   c. Grooves in the rotor surface are acceptable only if they are less than 0.06" (1.5 mm) deep ***(Area C)***.
   d. Cracks that run completely to either edge of the hub are NOT acceptable, regardless of depth ***(Area D)***.
2. Measure the brake rotor thickness and re-surface, if necessary. For proper brake function, the minimum thickness for re-surfacing the brake rotor is defined as 1.54-1.57" (39-40 mm).

⚠WARNING Re-surfacing the brake rotor beyond the minimum thickness could cause component failure which, if not avoided, could result in death or serious injury.

IMPORTANT: DO NOT use high-pressure cleaners or liquid cleaners on the brake rotor.

If the overall wear limits for the brake rotor or brake pads are exceeded ***(Figure 6)***, the rotor and pads MUST be replaced. Refer to rotor replacement instructions as detailed in Section 8. For brake pad replacement, refer to instructions available on the Knorr/Bendix website.

For both the inner and outer pads, the maximum brake pad wear difference is 0.2" (5.0 mm).

BRAKE ROTOR			BRAKE PAD	
DIAMETER	"A" NEW	"B" WEAR LIMIT	"C" NEW	"D" WEAR LIMIT
430 mm	45 mm	37 mm	30 mm	11 mm
16.93"	1.77"	1.46"	1.18"	0.43"

⚠WARNING Failure to replace brake rotor and pads when minimum wear limits are reached could cause component failure which, if not avoided, could result in death or serious injury.

NOTE: When replacing the brake pads or brake rotor, use only Original SAF-HOLLAND® rotors and approved brake pads.

IMPORTANT: When replacing worn brake pads, ALL pads on the axle MUST be replaced.

NOTE: During brake repairs, conduct a visual inspection of the seals on the brake caliper. Refer to Section 5.3 for more information.

Figure 5

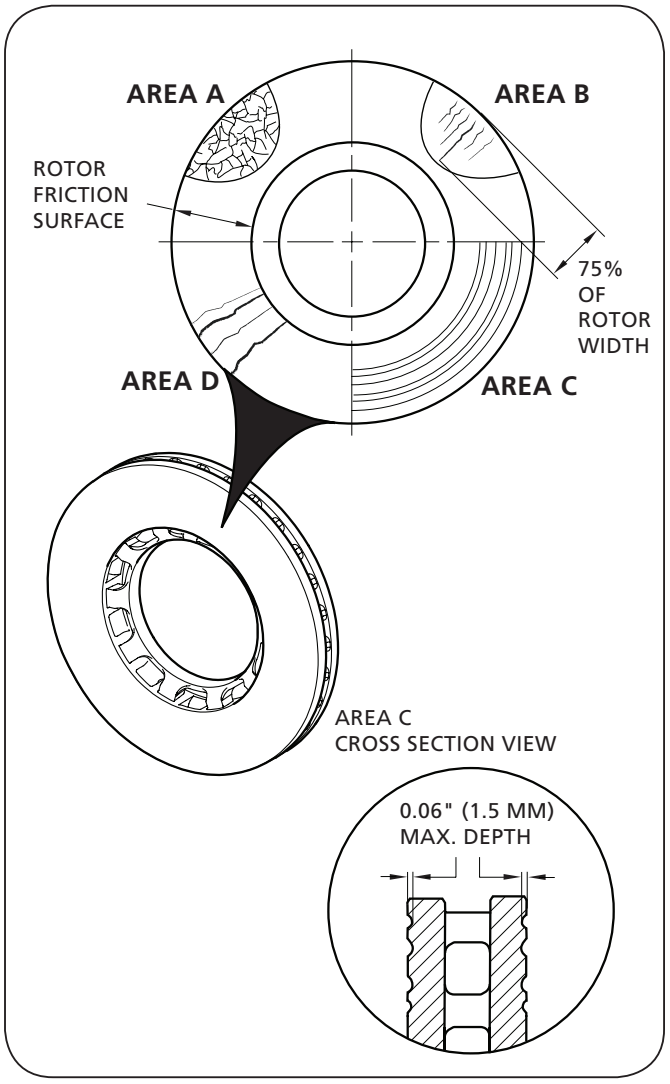
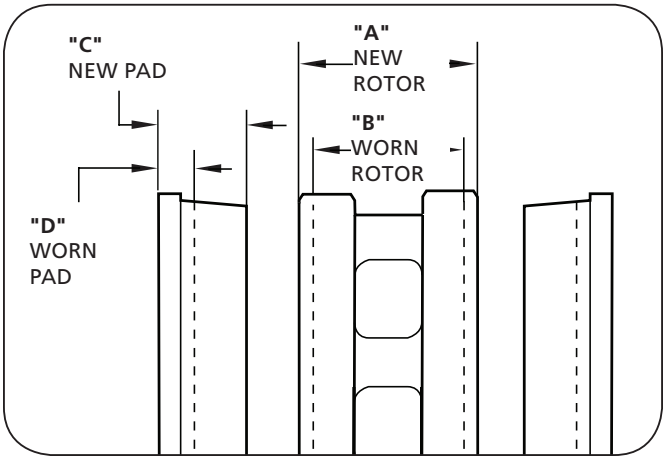


Figure 6



5.3 Brake Caliper Inspection

For instructions on brake caliper inspection and repair, refer to the Knorr/Bendix SK7 Caliper service data sheet "SD-23-7541 Air Disc Brake" which can be found at www.bendix.com.

6. Standard Bearing Hub, Bearing and Seal Removal

NOTE: Before beginning any axle/brake service procedures, park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle and axles(s) with safety stands. DO NOT work under a vehicle supported only by jacks. Jacks can slip or fall over. Serious personal injury and damage to components can result.

⚠WARNING Failure to properly support the vehicle and axles prior to commencing work could create a crush hazard which, if not avoided, could result in death or serious injury.

1. Release the trailer brakes, and cage the spring brakes according to the spring brake manufacturer's instructions. Remove the tire and wheel assembly to access hub and rotor.
2. Remove wheels from hub using support device such as a wheel dolly.

⚠CAUTION Failure to support weight during installation or removal of wheels could create a crush hazard which, if not avoided, could result in minor to moderate injury.

3. Remove the ABS sensor by following the instructions detailed in Section 15.1.
4. Detach the brake chamber from the brake caliper by loosening and removing the two (2) mounting nuts ***(Figure 7)***.
5. Remove the brake caliper from the brake spider by using a size 24 mm socket to loosen. Discard all four (4) brake caliper bolts ***(Figure 8)***.

Figure7

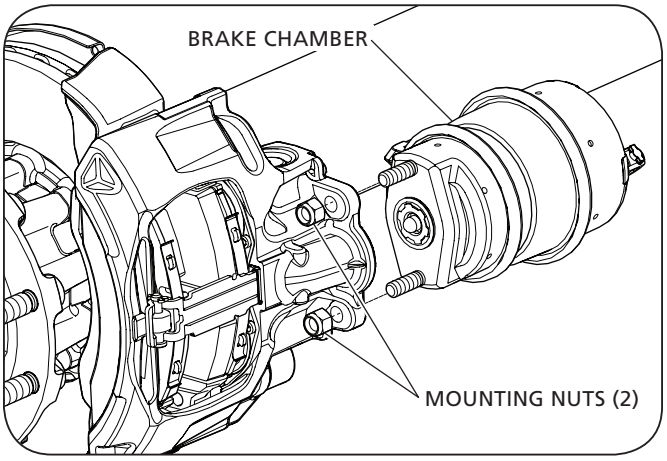
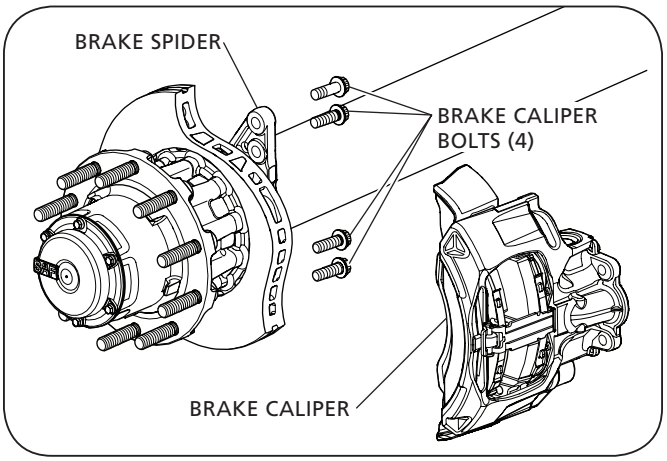


Figure 8



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6. With a 1/2 socket, remove the six (6) hub cap bolts and the hub cap ***(Figure 9)***.

IMPORTANT: The red dot in the middle of the SAF® plastic hub cap is permanent and MUST NOT be removed.

NOTE: Be prepared to collect lubrication fluid when removing hub cap.

7. Utilizing a screwdriver, carefully pry the orange keeper arm from the undercut groove on each side of the Pro-Torq® wheel nut until the keeper is released from it ***(Figure 10)***.
8. Using a standard 4-13/16" P-Spindle wheel nut socket, remove the axle spindle nut (Pro-Torq®) by rotating the nut in a counter-clockwise direction ***(Figure 10)***.

NOTE: All axle nuts on SAF-HOLLAND® INTEGRAL® P89 Disc Brake Axles are right-hand threaded.

9. Remove the outer hub bearing from the spindle ***(Figure 10)***.

NOTE: With the Pro-Torq® nut removed, it is possible to access the outer bearing.

⚠CAUTION DO NOT hit steel parts with a steel hammer as parts could break, sending flying steel fragments in any direction creating a hazard which, if not avoided, could result in minor to moderate injury.

10. Grasp the head unit with both hands and pull the head unit off the axle spindle ***(Figure 11)***.

NOTE: Depending on type of hub seal, the hub seal and inner bearing may remain on spindle or come off with the head unit.

Figure 9

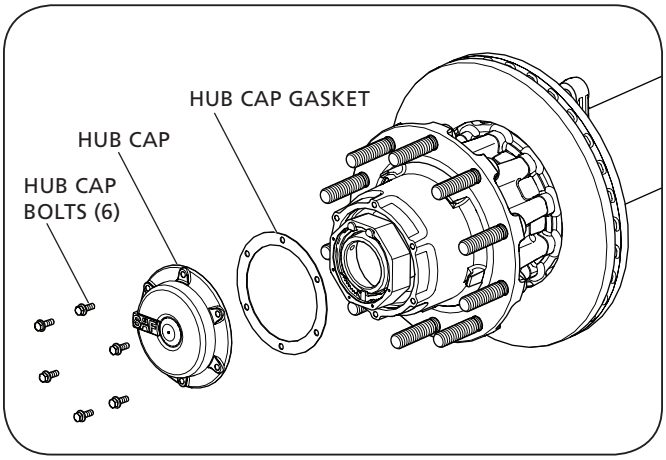


Figure 10

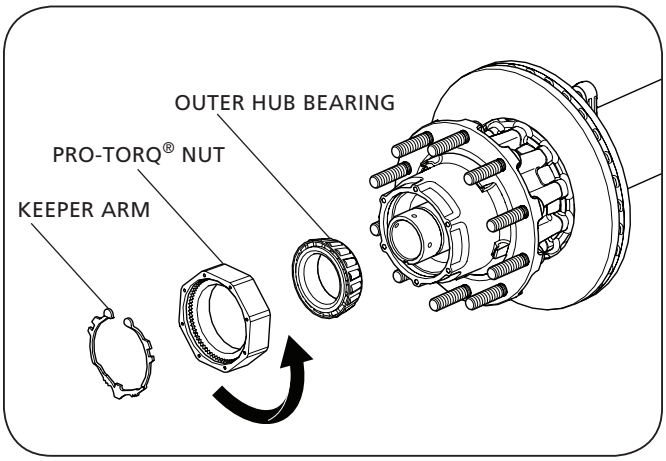
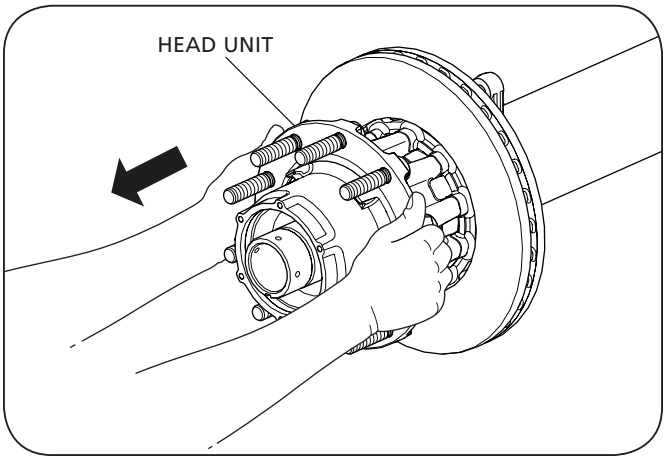


Figure 11



11. Remove the inner hub bearing from the spindle or from the inside of the hub ***(Figure 12)***.
12. The spindle mount hub seal can be driven off the spindle by striking the ring from the back side or prying off with a crow's foot bar. Be careful not to gouge the spindle shoulder. Discard the used seal. A new seal is required when re-assembled ***(Figure 12)***.

CAUTION DO NOT use a chisel to cut the seal. The shoulder can be damaged, resulting in a leak which, if not avoided, could lead to wheel end and/or brake failure.

7. Bearing Inspection

CAUTION Thoroughly clean bearings. DO NOT mix a synthetic base grease or oil with an organic/mineral base lubricant.

CAUTION DO NOT dry hub bearings with compressed air. Bearing damage could result.

1. After removing the head unit, clean excess grease from the bearings.

IMPORTANT: A bearing which has been removed from a vehicle should be cleaned with solvent. NEVER use steam or water which will rust bearings.

IMPORTANT: Bearings that are rusted, flaked, pitted, or have damaged cages should be replaced. It is recommended to replace all questionable bearings and ALWAYS replace the cup and cone as a matched set.

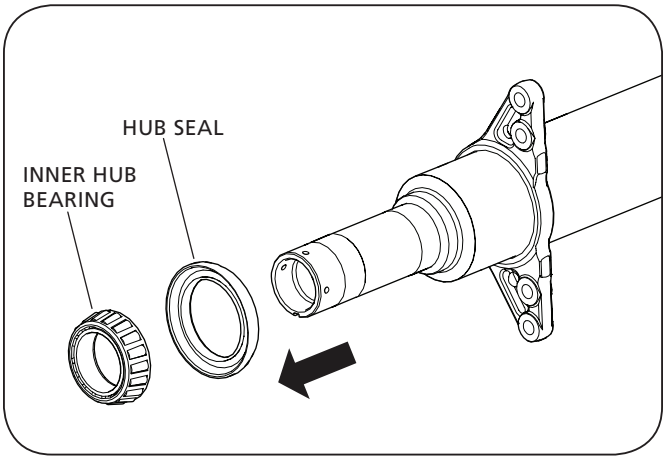
IMPORTANT: NEVER re-assemble a tapered roller bearing in a damaged or worn bearing cup or spindle. Bearing cup or spindle should be replaced and NOT re-machined if damaged or worn.

8. Rotor Replacement

⚠WARNING Failure to follow these instructions could cause component failure which, if not avoided, could result in death or serious injury.

1. Remove the ABS sensor by following the instructions detailed in Section 15.1.
2. Remove the head unit, refer to Section 6 instructions.

Figure 12



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3. Remove the rotor from the head unit using a size 15 mm socket to loosen and discard all ten (10) connection bolts ***(Figure 13)***.
4. Clean the rotor contact surface on the head unit. Using compressed air, clean the tapped holes in the disc unit. Check to make sure the threads are undamaged.
5. Attach the new rotor to the hub using ten (10) new SAF® specific INTEGRAL® bolts ***(Figure 13)***. Using a torque wrench, pre-torque the bolts to 37 ft.-lbs. (50 N•m). For final torque, tighten the bolts an additional 120° (1/3 turn) using a crisscross pattern. Refer to the Torque Chart in Section 18 for more information.

IMPORTANT: When attaching a new rotor to the head unit, use only new SAF® specified connection bolts. Bolts MUST be clean and free from oil and grease.

⚠WARNING Failure to use only SAF® specified connection bolts could cause component failure which, if not avoided, could result in death or serious injury.

9. Hub Wheel Bolt Servicing

When replacing the wheel bolts, refer to the rotor removal instructions described in Section 8.

NOTE: NOT all bolts may need to be replaced. ONLY replace bolts that are damaged or in need of replacement.

1. Remove the wheel bolts by pressing them out of the head unit and discard ***(Figure 14).***
2. Install new wheel bolts by pressing them into the head unit. To ensure correct alignment of the bolts during installation, position the flat side of each wheel bolt head so that it is facing the center of the hub ***(Figure 15)***.

⚠CAUTION DO NOT hit steel parts with a steel hammer as parts could break, sending flying steel fragments in any direction creating a hazard which, if not avoided, could result in minor to moderate injury.

Figure 13

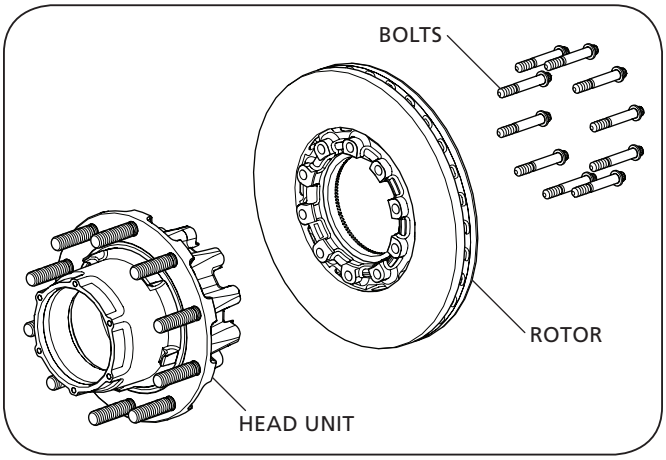


Figure 14

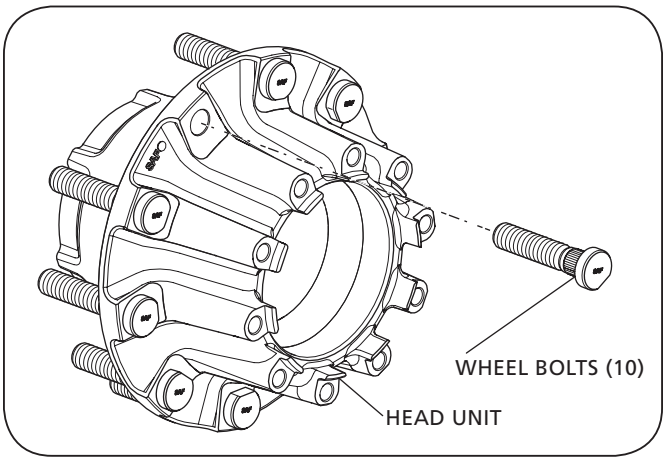
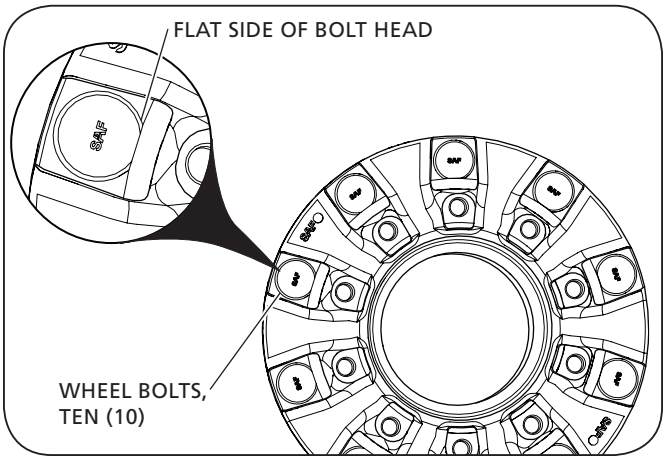


Figure 15



10. Seal, Bearing, and Hub Installation and Adjustment

IMPORTANT: DO NOT mix oil and grease wheel end lubricants. Although all SAF-HOLLAND® P89 INTEGRAL® Disc Brake wheel ends are factory lubricated with NLGI 00 semi-fluid grease, wheel end can be serviced with oil or grease. Before servicing the SAF-HOLLAND® P89 wheel end with oil, all grease MUST be cleaned with appropriate solvent from the bearings and hub.

NOTE: Athough all SAF-HOLLAND® P89 INTEGRAL® Disc Brake wheel ends are manufactured with spindle mounted wheel seals they can be serviced with either spindle or hub mounted seals.

10.1 Spindle mounted wheel seal Installation instructions. (Refer to 10.2 for hub mounted wheel seal instructions.

1. Before installing the wheel seal on the axle spindle, inspect the machined spindle seal surface for nicks, scratches, burrs or marks. If needed, use crocus cloth or emery cloth to repair any damaged areas.
2. Clean the threads and keyway thoroughly with a wire brush to avoid false bearing adjustments and to avoid introduction of contaminants into the lubricant cavity.
3. Thoroughly clean the spindle and spindle threads of rust, dirt, grease or any other contaminants that could damage the hub seal and cause it to leak.

CAUTION NEVER install a spindle mounted wheel seal in the hub and then force it onto the axle spindle by tightening the axle nut. Damage to seal will result.

CAUTION To avoid damaging the seal, support the hub against the spindle inner shoulder until the outer bearing and adjusting nut are installed.

4. Apply a thin layer of sealant to the O.D. of the spindle shoulder. Place the wheel seal on the spindle with the side labeled "oil-bearing side" facing out towards the end of the spindle ***(Figure 16)***.
5. Seat wheel seal into place using a hub seal installation tool and hammer. Rotate the wheel seal installation tool 1/4-turn with every hammer tap until the seal is properly seated with the metal face of the seal flush with the inner shoulder of the axle spindle ***(Figure 17)***. Clean and remove any excess sealant.
6. Prepare the hub. Remove the old lube and thoroughly clean the hub cavity and hub bore. If needed, use emery cloth to remove any burrs or old bore sealant. Inspect the hub bore for damage. Replace if necessary.
7. Install new inner and outer bearing cups into the hub as necessary ***(Figure 18)***.

Figure 16

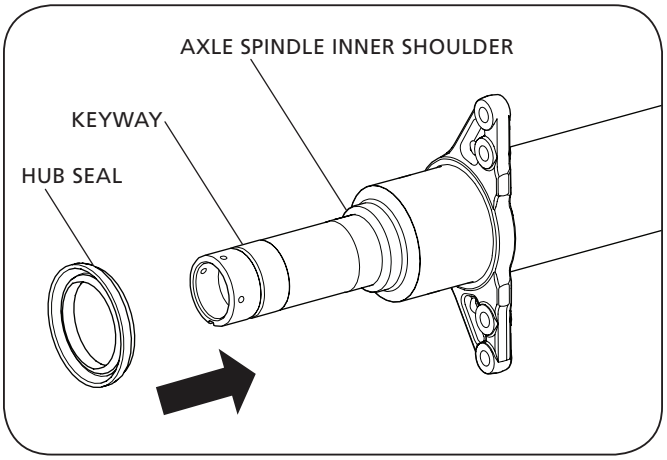


Figure 17

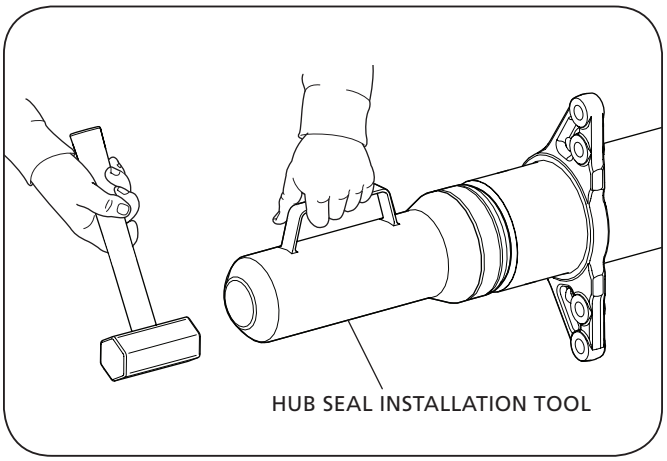
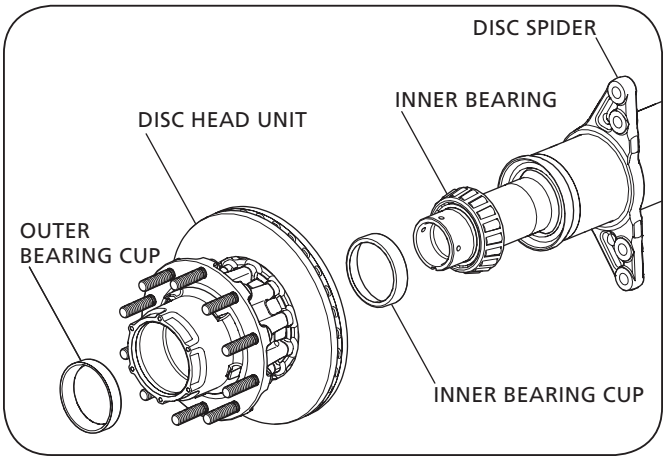


Figure 18



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8. Install inner bearing on spindle ***(Figure 18)***.

NOTE: If using oil for lubrication, coat bearings with oil before installation. Refer to Section 11 for proper wheel end oil lubrication instructions ***(Figure 18)***.

CAUTION Failure to lubricate bearing correctly and maintain proper lubrication could result in bearing damage.

NOTE: If using grease and NOT oil for hub lubrication, the inner and outer bearing, and the hub cavity MUST be pre-packed with grease before installation. Lubricate wheel end components with grease specified in Section 16.

9. Lubricate inside of hub cavity and install on spindle ***(Figure 18)***.

NOTE: Be sure wheel seals are properly installed before performing the hub bearing adjustment procedure.

10.2 Hub Mounted Wheel Seal Installation Instructions

1. Remove all burrs from the hub bore and spindle. Thoroughly clean hub cavity and spindle.

NOTE: DO NOT apply any sealant to the spindle shoulder.

2. Place the hub on a smooth, hard surface in a horizontal position. Pre-lube the inner bearing and place it into the hub bearing cup ***(Figure 19)***.

NOTE: When using grease, pre-pack the inner bearing before placement into the hub.

3. Place the wheel seal on the installation tool, make sure that the words "oil-bearing side" faces the inner bearing. Position the tool (with the seal correctly mounted in the tool head) into the hub bore. Use a three to five pound hammer to drive against the end of the tool. Drive seal into bore until complete bottoming is assured ***(Figure 20)***. Remove the installation tool and apply a thin layer of lubricant on the I.D surface of the seal.

NOTE: DO NOT apply lubricant to the O.D. of the seal.

4. Gently push the head unit onto the spindle to the proper position. Fill the hub cavity with lubricant until it runs over the outer bearing cup. Coat the outer bearing with lubricant and place the outer bearing on the spindle and into the bearing cup ***(Figure 21)***.

NOTE: When using grease, pre-pack the hub cavity. The grease fill amount should be to a 3 o'clock and 9 o'clock level. This is to ensure a 50% hub cavity fill. Use a template to hold grease in place while filling the hub cavity ***(Figure 21)***.

CAUTION DO NOT ram the hub into the spindle bearing shoulder. This could damage the wheel seal.

Figure 19

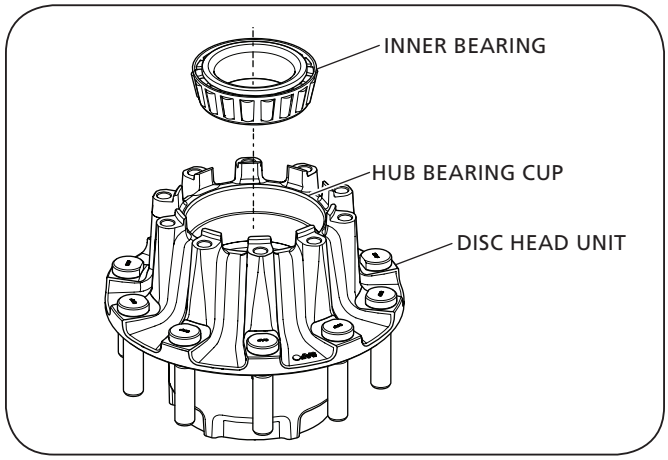


Figure 20

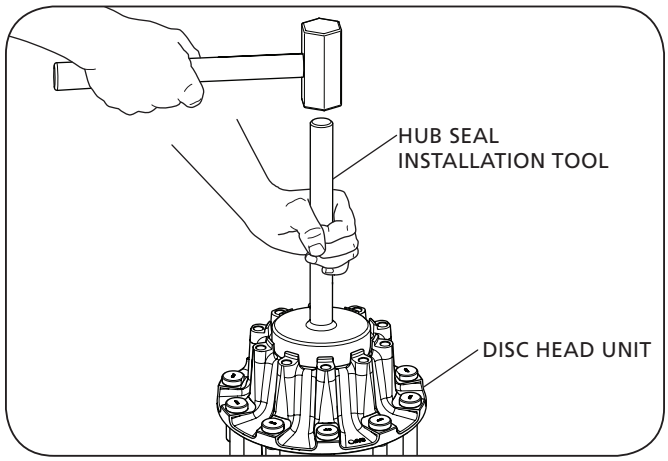
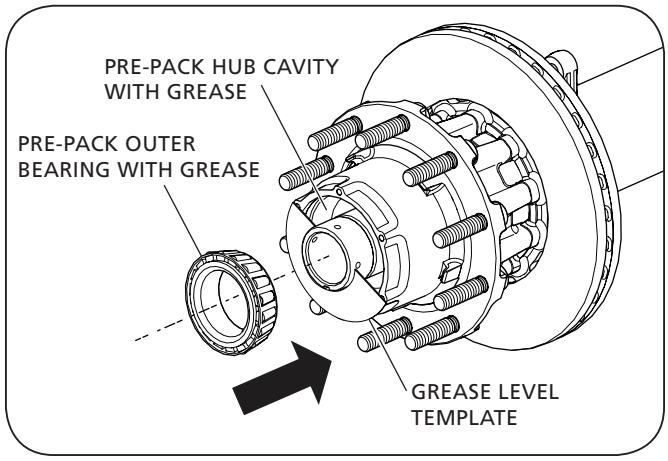


Figure 21



5. Install outer bearing on spindle.
6. Install the Pro-Torq® wheel nut onto the spindle threads ***(Figure 22)***.
7. Adjust the bearing using the Pro-Torq® axle nut:
   a. Use a screwdriver to carefully pry the keeper arm from the undercut groove on each side until the keeper is released.
   b. Seat the bearing. Using a torque wrench, tighten the nut to 200 ft.-lbs. (271 N•m) and spin the wheel at least one (1) full rotation. PERFORM THIS STEP THREE (3)TIMES.
   c. Back the nut off until it is loose.
   d. Adjust the bearing. Using a torque wrench, tighten the nut to 100 ft.-lbs. (137 N•m). Spin the wheel at least one (1) full rotation. PERFORM THIS STEP THREE (3) TIMES.
   e. Back the nut off one raised face mark (1/8 of a turn).
   f. Install the keeper with orange side facing out by inserting the keeper tab into the undercut groove of the nut and engage the keyway tang in the axle keyway. Insert keeper tab with bent legs facing out.
   g. Engage the mating teeth of the keeper with the teeth of the wheel nut.
   h. Compress and insert the keeper arms, one at a time, into the undercut groove with a screwdriver.
   i. If the keeper teeth DO NOT line up with teeth in nut, loosen the nut slightly until they engage.

IMPORTANT: DO NOT tighten nut to align teeth.

CAUTION Failure to properly tighten nut could result in bearing damage which, if not avoided, could result in bearing failure.

   j. Using a dial indicator, verify that end play reading is .001" (0.03 mm) to .003" (0.08 mm). Re-adjust bearing, if necessary.
8. Make sure that the keeper tab and keeper arms are fully seated into the undercut groove. Inspect the keyway tang to ensure it does not contact the bottom of the keyway ***(Figure 23)***. If contact exists, immediately notify a Pro-Torq® representative.

⚠WARNING Failure to ensure that the keeper is properly installed could cause wheel separation which, if not avoided, could result in death or serious injury.

9. Check the wheel bearing end play as follows:
   a. Attach the magnetic base of a dial indicator to the spindle. Touch dial indicator stem to hub cap gasket face ***(Figure 24)***.
   b. Reading Number One - Slightly rotate wheel-end in both directions while pushing inward until dial indicator does not change. Set the dial indicator to zero ***(Figure 24)***.
   c. Reading Number Two - Slightly rotate hub in both directions while pulling outward until dial indicator does not change ***(Figure 24)***.

Figure 22

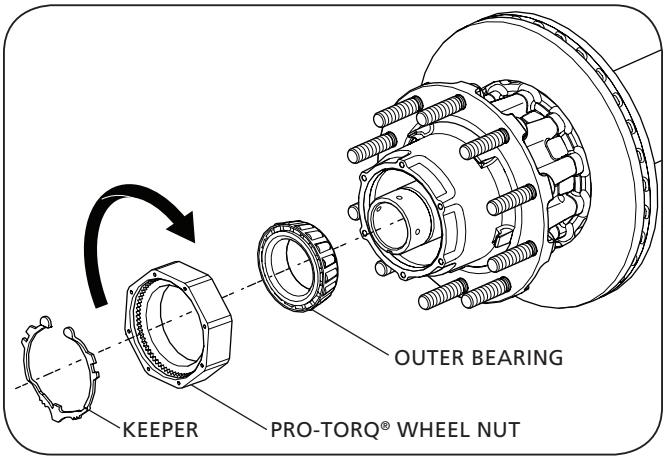


Figure 23

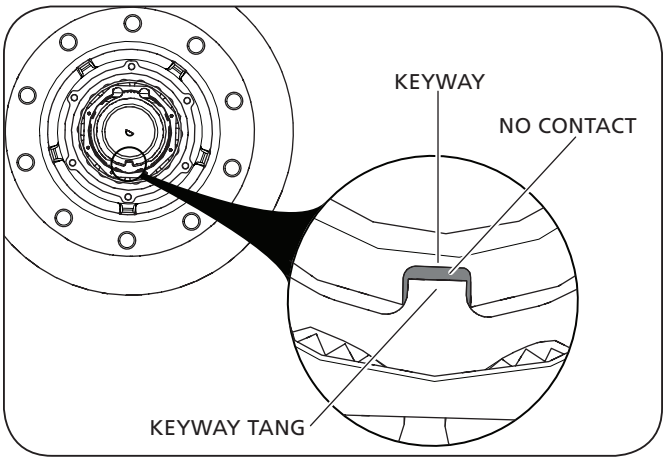
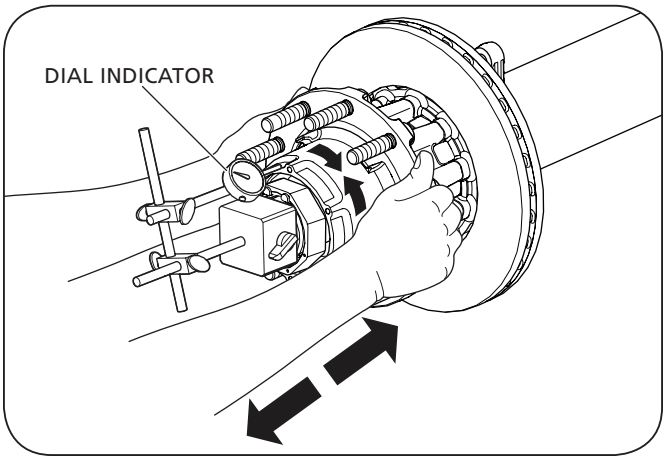


Figure 24



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d. End play is the difference between reading number one and reading number two.

NOTE: Final adjustment should allow the wheel to rotate freely with 0.001" - 0.003" (0.03 mm - 0.08 mm) end play. If end play is not within specification, re-adjustment of bearing is required.

IMPORTANT: If end play is not within specification, re-adjustment is required.

⚠WARNING Failure to maintain proper hub bearing adjustment could allow bearing failure and wheel-end separation which, if not avoided, could result in death or serious injury.

11. Hub Lubrication (Oil)

IMPORTANT: DO NOT mix oil with grease. If the bearing assembly has been lubricated with grease, DO NOT add oil.

⚠WARNING Failure to correctly lubricate bearings could damage bearings which, if not avoided, could result in death or serious injury.

1. Remove plug and fill the hub to the FULL mark with specified lubricant (oil), through the hole in the hub cap ***(Figure 25).***
2. Allow the oil to flow through the bearings and level off.
3. Insert the plug into the hole in the hub cap ***(Figure 25).***

IMPORTANT: Axles equipped with a centralized tire inflation system MUST use a vented hub cap.

4. Re-install wheel on hub using support device such as a wheel dolly jack.

⚠CAUTION Failure to support weight during installation or removal of brake drum could create a crush hazard which, if not avoided, could result in minor to moderate injury.

CAUTION Failure to uncage spring brakes in accordance with manufacturer's instructions after servicing is complete will prohibit proper brake function which could result in uneven brake system component wear.

12. Hub Cap Installation

1. Install the hub cap assembly, making sure the hub cap gasket is in place ***(Figure 26)***.

IMPORTANT: When installing hub cap, make sure the hub cap gasket is not bent or damaged.

IMPORTANT: DO NOT over torque. This can crush the hub cap gasket.

CAUTION Failure to avoid damaging the hub cap gasket could allow lubricant to lead which, if not avoided, could result in bearing failure.

2. Install the six (6) bolts to secure the hub cap assembly ***(Figure 26)***. Tighten bolts to 12-16 ft.-lbs. (16-21 N•m).

Figure 25

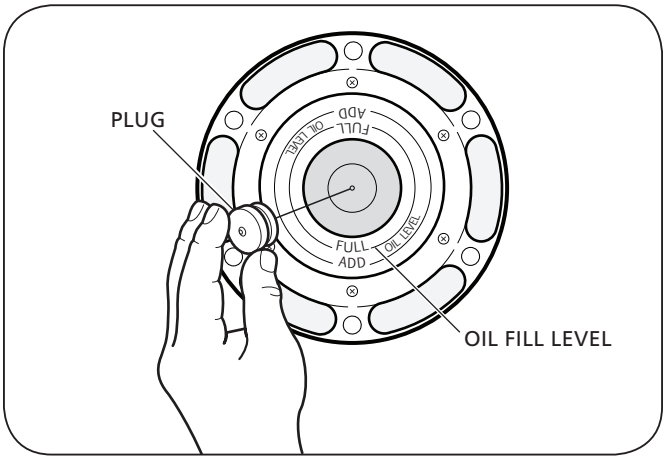
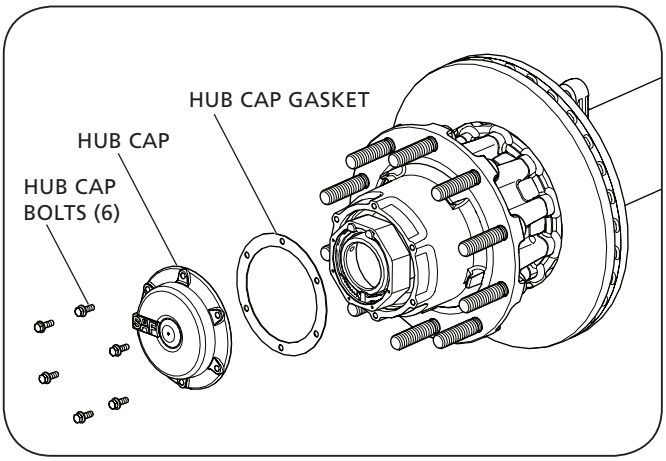


Figure 26



13. Caliper Installation

1. Re-install the caliper onto the brake spider using four (4) new SAF® specific brake caliper bolts ***(Figure 27):***
   a. Pre-torque the bolts to 88 ft.-lbs. (120 N•m) from inner bolts to outer bolts using a size 24 mm socket.
   b. Verify the pre-torque of the bolts a second time, and if necessary re-tighten all bolts to 88 ft.-lbs. (120 N•m).
   c. Final torque from inner bolts to outer bolts to 331 ± 22 ft.-lbs. (450 ± 30 N•m).

NOTE: The caliper is connected to the disc brake spider using four (4) SAF specific bolts: three (3) standard bolts and one (1) shoulder bolt ***(Figure 27).*** The shoulder bolt is located at the top mounting hole whether the caliper is installed forward or rearward of the axle.

IMPORTANT: Make sure that the brake caliper is mounted on the correct side of the axle. The correct position can be identified by the lengths of the guide pins on the caliper unit. The longer guide pins should be positioned on the bottom of the caliper unit when installed rear of the axle and on top when forward of the axle ***(Figure 28).***

2. Re-install the SAF® brake chamber by following the instructions in SAF® Brake Chambers Installation and Service Guide XL-SA10062IM-en-US available on the internet at www.safholland.us.
3. Re-install the ABS sensor by following the instructions detailed in Section 15.1.
4. To enable the ABS sensor to function properly press the ABS sensor against the ABS toner ring at the hub unit to eliminate any clearance between these parts.

IMPORTANT: After replacing the rotor, verify that the brake system is functioning properly.

⚠WARNING Failure to verify brake system function after rotor replacement could result in brake malfunction which, if not avoided, could result in death or serious injury.

Figure 27

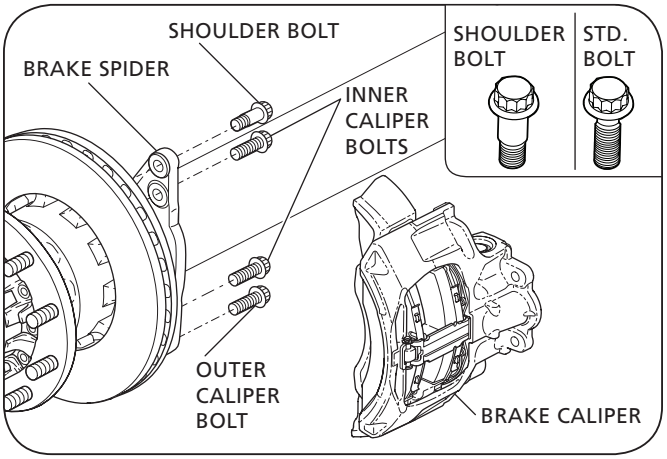
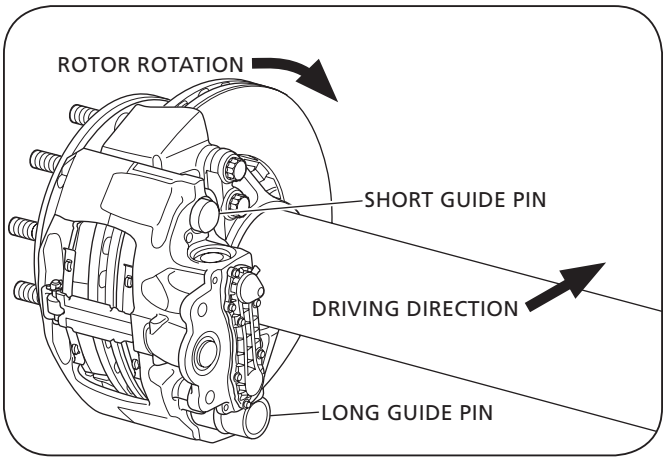


Figure 28



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14. Brake Caliper Servicing

For instructions on brake caliper and repair/replacement, refer to the Knorr/Bendix SK7 Caliper service data sheet SD-23-7541 Air Disc Brake which can be found on the internet at www.bendix.com.

15. Disc Brake Options

15.1 ABS Sensor

NOTE: When replacing the ABS sensor, DO NOT mix sensors from different manufacturers. Only install a sensor manufactured by WABCO. For further ABS sensor information, contact SAF-HOLLAND® Customer Service at 888-396-6501.

1. Disconnect the ABS sensor.
2. Remove the ABS sensor from the sensor holder by pulling it straight out from the holder and discard ***(Figure 29).***
3. If necessary, remove the sensor retaining spring clip from the sensor holder and replace with a new clip. ***(Figure 29).***
4. Install a new ABS sensor by pushing it directly into the sensor holder/spring clip until it contacts the ABS toner ring in the hub assembly ***(Figure 29).***
5. Re-connect the ABS sensor.

15.2 Hubodometer

The SAF-HOLLAND® INTEGRAL® P-Spindle Disc Brake axle can be factory equipped or retrofitted with any hubodometer currently compatible with a North American standard P-Spindle six bolt hub cap. For information on specific hubodometer availability, contact SAF-HOLLAND® Customer Service at 888-396-6501.

15.3 Tire Inflation System

SAF-HOLLAND® does not supply tire inflation systems. However, the SAF-HOLLAND® INTEGRAL® P-Spindle Disc Brake axle can be factory equipped to be compatible with many tire inflation systems currently compatible with a North American standard P-Spindle six bolt hub cap. This includes providing tire inflation system hubcaps that are compatible with hubodometers. For information on specific Tire Inflation fitting availability, contact SAF-HOLLAND® Customer Service at 888-396-6501.

15.4 Dust Shield

The SAF-HOLLAND® INTEGRAL® Disc Brake can be factory equipped or retrofitted with a disc dust shield.

1. Install the dust shield as illustrated ***(Figure 30)***.
2. Remove clamp band bolt and wrap clamp band around axle.
3. Insert clamp band bolt and tighten to 20-25 ft.-lbs. (27-34 N•m) using a 13 mm socket.

Figure 29

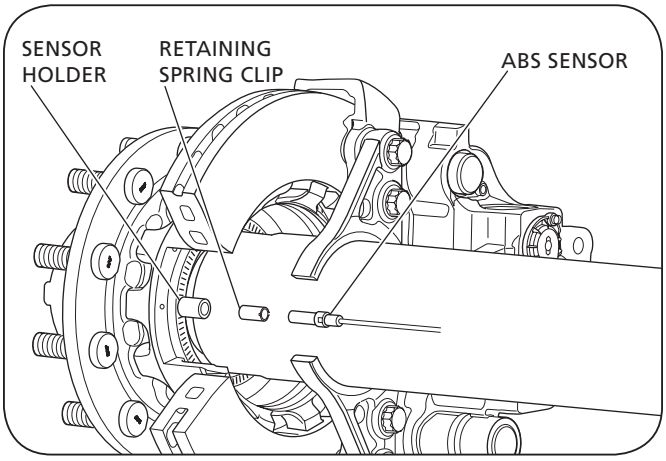
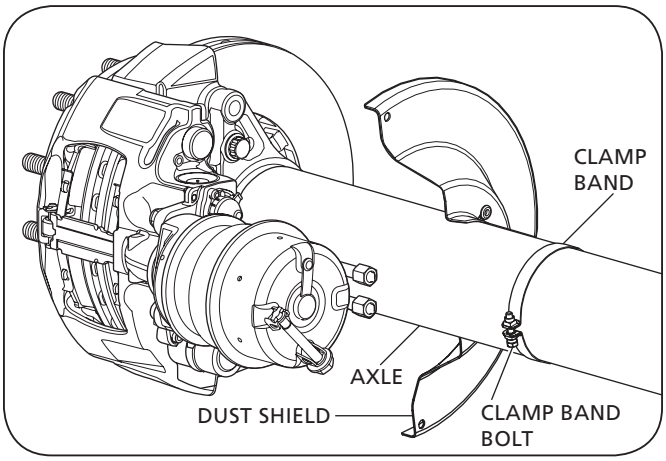


Figure 30



16. Lubrication and Torque Specifications

LUBRICATION SPECIFICATION		
COMPONENT	SURFACE TO BE LUBRICATED	TORQUE VALUE
Axle	Bearings and Hubs	NLGI 00 Semi-Fluid Grease

* Oil lubed bearings and hubs should remain lubricated with oil, grease lubed bearings and hubs should remain lubricated with grease.

NOTE: Intervals are based upon normal operations. Reduce intervals to compensate for abnormal operations or severe conditions. During inactive periods, sufficient lubrication MUST be performed for equipment preservation.

PART	APPLICATION	TORQUE SPECIFICATIONS
Pro-Torq® Axle Spindle Nut 3.48-12 UNS 2A	P-Spindle Bearing System	While rotating the hub, torque to 500 ft.-lbs. (680 N•m)
SAF® Specific INTEGRAL® Bolt M14 x 1.5"	Rotor – Hub	Torque all ten (10) bolts in a criss-cross pattern. 1. Pre-torque to 37 ft.-lbs. (50 N•m). 2. For final torque tighten by an additional 120° turn.
SAF® Specific Caliper Bolt M18 x 1.5"	Caliper – Spider	Torque bolts from inner bolts to outer bolts. 1. Pre-torque to 88 ft.-lbs. (120 N•m). 2. Verify the pre-torque of the bolts a second time, and, if necessary re-tighten all bolts to 88 ft.-lbs. (120 N•m). 3. Final torque from inner bolts to outer bolts to 331 ± 22 ft.-lbs. (450 ± 30 N•m).
SAF® Specific Brake Chamber Nut 5/8"-11 UNC Nylock or M16 x 1.5"	Brake Chamber	1. Pre-torque both chamber nuts to 60-75 ft.-lbs. (80-100 N•m). 2. For final torque tighten both chamber nuts to 130-155 ft.-lbs. (180-210 N•m)
5/16"-18 Bolt	Hub Cap	12-16 ft.-lbs. (16-22 N•m)
M8 x 1.25" Bolt	Dust Shield Clamp	20-25 ft.-lbs. (27-34 N•m)

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17. Routine Service Schedule

⚠WARNING Failure to inspect and maintain the SAF-HOLLAND® INTEGRAL® disc brake axle as outlined in Section 17 can result in brake or wheel bearing failure which, if not avoided, could result in death or serious injury.

IMPORTANT: Use only SAF-HOLLAND® Original Parts to service the SAF-HOLLAND® INTEGRAL® disc brake axle.

⚠WARNING Failure to maintain the SAF-HOLLAND® INTEGRAL® disc brake with SAF-HOLLAND® Original Parts can result in brake or wheel bearing failure which, if not avoided, could result in death or serious injury.

NOTE: Service intervals are based upon normal operations. Reduce intervals to compensate for abnormal operations or severe conditions. During inactive periods, sufficient lubrication MUST be performed for equipment preservation.

			PERIODIC CHECKS	
WHICHEVER OCCURS FIRST	MILEAGE INTERVALS	After First 3,000 Miles	Every 20,000 Miles	Every 50,000 Miles
	TIME INTERVALS	After First Month	Every 3 Months	Every 6 Months
VISUAL AND SAFETY INSPECTION				
Head Unit – Check for grease leaks.				■
Inspect the brake caliper guide system. Check for free movement and sliding action. Refer to Section 5.3.				■
Check rubber dust covers for cracks and damage. Check adjuster cap for correct seating. Refer to Section 5.3.				■
Inspect brake pad thickness regularly. Refer to Section 5.			■	
Inspect brake rotors for cracks. Refer to Section 5.				■
Perform general service/maintenance inspection. Refer to Section 2.		■		
Perform disc brake/head unit inspection. Refer to Section 5.		■		■

MECHANICAL CHECK
Attention: Check torque of wheel nuts after the first 5-100 miles (8-160 km) from date vehicle was placed into service and after every wheel removal. Continually check wheel torque every 10,000 miles (16,000 km), or at the intervals indicated in the vehicle owner's manual, whichever occurs first.

SPECIAL SERVICE CONDITIONS	
Vehicles with long standing periods.	Service at specified time intervals, e.g. Trailer used for storage or frequently left standing for several days at a time.
Vehicles used under severe duty and extreme conditions.	Service at suitably reduced intervals, e.g. Trailer operating in continuous multi-shifts or in off-road construction sites.

18. Troubleshooting Chart (SAF-HOLLAND® suspensions equipped with disc brake axles)

PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Brakes will not release	Disc brake caliper bound up	Lubricate or replace brake caliper
	Brake hoses restricted	Replace hoses
	Brake control valve restricted/inoperable	Repair/replace control valve
	Brake out of adjustment	Adjust brake/repair or replace automatic adjustment device as necessary
	Damaged brake chamber	Replace brake chamber
	Damaged brake assembly	Replace or repair brake assembly
	Supply air interrupted	Open glad hand cut-out cock or push brake control valve in
	Supply line improperly coupled	Properly couple supply air line
	Brake pads frozen to rotor in cold weather	Warm brakes
No brakes or insufficient brake performance	Service air interrupted	Open glad hand cut-out cock
	Service air line improperly coupled	Properly couple service air line
	Brake hoses restricted	Relieve restriction or obstruction or replace hoses
	Brake control valve restricted/inoperable	Repair/replace control valve
	Brake out of adjustment	Adjust brake/repair or replace automatic adjustment device as necessary
	Damaged brake chamber	Replace brake chamber
	Damaged brake assembly	Replace or repair brake assembly
Dragging Brakes/Slow brake application or release timing	Brake hoses restricted	Relieve restriction or obstruction or replace hoses
	Brake control valve restricted/inoperable	Repair/replace control valve
	Brake out of adjustment	Adjust brake/repair or replace automatic adjustment device as necessary
	Damaged brake chamber	Replace brake chamber
	Damaged brake assembly	Replace or repair brake assembly
Dog Tracking	Axle not properly aligned	Align axle
	Slider assembly racked or not aligned properly	Repair or replace slider assembly
	Frame bent or not aligned properly	Repair or align frame
	Damaged suspension component	Repair or replace suspension component
	Bent axle	Replace axle
Uneven tire wear	Improper tire inflation	Inflate tire to proper pressure
	Loose wheel stud nuts	Inspect for and repair any resultant wheel end damage and tighten properly
	Improper wheel bearing adjustment	Inspect for and repair any resultant wheel end damage and adjust properly
	Axle not properly aligned	Align axle
	Slider assembly racked or not aligned properly	Repair or replace slider assembly
	Frame bent or not aligned properly	Repair or align frame
	Damaged suspension component	Repair or replace suspension component
	Bent axle	Replace axle
	Mismatched tire sizes	Properly match tire sizes
	Unequal brake balance or timing	Repair brakes as necessary
	Overly aggressive braking	Instruct/train driver in proper brake use
	High speed turns	Instruct/train driver in proper vehicle speeds
	High level of side scrub	Instruct/train driver in proper vehicle maneuvering
	Anti-Lock Brake System malfunction	Refer to ABS manufacturer's service literature

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PROBLEM	POSSIBLE CAUSE	POSSIBLE REMEDY
Grabbing brakes	Contaminants on brake lining	Replace brake pads
	Brake out of adjustment	Adjust brake/repair or replace automatic adjustment device as necessary
	Warped brake rotor	Machine or replace brake rotor
	Damaged brake chamber	Replace brake chamber
	Damaged brake assembly	Replace or repair brake assembly
	Unequal brake balance or timing	Repair brakes as necessary
	Anti-Lock Brake System malfunction	Refer to ABS manufacturer's service literature
Excessive heat cracks in rotor	Brake out of adjustment	Adjust brake/repair or replace automatic adjustment device as necessary
	Overly aggressive braking	Instruct/train driver in proper brake use
	Unequal brake balance or timing	Repair brakes as necessary
	Anti-Lock Brake System malfunction	Refer to ABS manufacturer's service literature
	Damaged brake chamber	Replace brake chamber
	Damaged brake assembly	Replace or repair brake assembly

SAF-HOLLAND ORIGINAL PARTS™

From fifth wheel rebuild kits to suspension bushing repair kits, SAF-HOLLAND Original Parts are the same quality components used in the original component assembly.

SAF-HOLLAND Original Parts are tested and designed to provide maximum performance and durability. Will-fits, look-alikes or, worse yet, counterfeit parts will only limit the performance potential and could possibly void SAF-HOLLAND's warranty. Always be sure to spec SAF-HOLLAND Original Parts when servicing your SAF-HOLLAND product.

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